Preliminary Survey Tool Measuring Childhood Lead Poisoning through Spice and Home Remedy Exposure in North Carolina

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MASTER OF PUBLIC HEALTH

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Abstract

Spices and home remedies are a surprising avenue for lead poisoning in children but are all too often overlooked or under-reported due to a lack of awareness. Spices and home remedies are given to children in order to enhance flavors or relieve ailments. Lead poisoning is a common, preventable - yet detrimental - pediatric environmental public health concern. It is known to cause learning disabilities, antisocial behavior, seizures, and even death. Most alarmingly, there can be no clinical symptoms. As the United States is a melting pot of cultures, there are pockets of at risk children, especially from South Asian, Hispanic, refugees, and children in federally funded programs, such as Medicaid. It is common in these households to consume an increased amount of spices and home remedies founded in traditions, norms, and beliefs. The Childhood Lead Poisoning Prevention Program in North Carolina's Department of Health and Human Services began to examine alternative approach in increasing level of lead exposure in respect to spices and home remedies.~~a side project to enhance reporting of these specific cases~~ .~~–~~Registered Environmental Health Specialists make home visits to children with elevated blood lead levels and require a consistent tool with high validity to document samples taken during calls (above the threshold of 5 µg per dL). By providing a useful data collection tool, the Food and Drug Administration (FDA) will be able to present accurate data models, generating stricter regulations and testing of imported spices and home remedies. This is imperative, as it will aide in demonstrating and bringing about awareness surrounding the lead health crisis in our youth.

Subject Keywords: Lead, Childhood Lead Poisoning, Spice, Home Remedy, Survey

Field Experience

Overview of North Carolina's Department of Health and Human Services

The Department of Health and Human Services manages a team of health professionals to work with community leaders, advocacy groups and stakeholders in order to deliver health services to the state's population. They focus on at risk populations such as children, elderly, disabled, and low-income families. The department's vision is to "Advance innovative solutions that foster independence, improve health, and promote well-being for all North ~~Carolinians~~[24]Carolinians[1]."

The department is divided into thirty divisions that fall into 4 basic umbrella categories: health, human services, administrative, and support functions. These divisions include: aging and adult services, human resources, office of rural health, public health, social services, and many more[124]. Focusing on my passion, I chose my field experience to take place in the Division of Public Health.

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Overview of North Carolina's Division of Public Health

The Division of Public Health promotes multiple health factors (prevention, health services, and health promotion) to protect communities from communicable diseases, epidemics, and contaminated food and water[124]. Their community-based health approach means working in local, state, and private sectors to monitor health statuses, diagnose health hazards, inform citizens, mobilize partnerships, develop policies, enforce laws, evaluate effectiveness, and research new solutions[124] (Figure 1).

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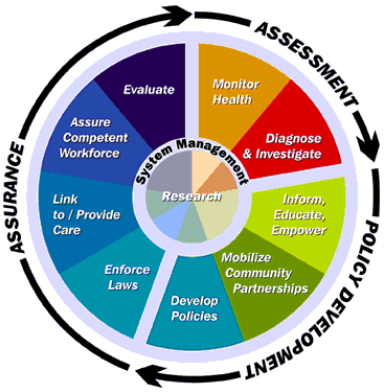
In its entirety, the Division of Public Health is further divided into sections based on what vital roles the section provides. Such sections include commission for public health, chronic disease and injury, environmental health, and epidemiology[1,2,4]. Although they work together toward the common core missions and functions, each of their contributions is completely singular. As humans are constantly interacting with the environment, environmental health affects many disparities, especially those who are already at risk. I have always been interested in environmental health as it is highly intertwined into affecting all points of quality living.

Figure 1: N.C. Public Health Wheel Graphic of Core Functions and Services



http://publichealth.nc.gov/library/images/phServiceWheel.gif

Overview of Environmental Health Section

The mission of the Environmental Health Section is not only to safeguard and promote human health, but also to protect the environment[1,2,4]. Through using modern surveillance technology, this section educates the public on food protection, water protection, and children's environmental health.

Overview of Children's Environmental Health Branch

The Children's Environmental Health Branch monitors sanitation requirements and lead poisoning prevention[1,2,4]. This branch not only regulates sanitation requirements for daycares and schools, it also boasts a number of trained health professionals to identify children with lead poisoning. It is within this program that I had the opportunity to conduct a field experience.

Overview of Childhood Lead Prevention Program

Located in Raleigh, North Carolina, the Childhood Lead Prevention Program's goal is to eliminate childhood lead poisoning through early identification, surveillance, abatement, monitoring, and assessment. During the spring semester of 2017, I partnered with Dr. Kim Gaetz, the Children's Public Health Epidemiologist, to conduct a field experience. As the Children's Public Health Epidemiologist, Dr. Gaetz plays a vital role in maintaining the children's lead surveillance system across the entire state. This electronic database is called "NC LEAD."

NC LEAD is a module of the Center for Disease Control and Prevention's electronic disease surveillance system, a movement to create web-based surveillance and reporting systems[1]. She coordinates with Registered Environmental Health Specialists (REHS) across the state to ensure that the database of all lead results (below and above the poisoning threshold) is current so that clinical and environmental data are available to

medical providers. Dr. Gaetz also ensures that all doctors, hospitals, and state and federal programs are following protocol for lead testing and reporting.

REHS has the skill sets to look for all sources of lead exposure in children. They inquire about the lifestyle of the child, including where they live or visit. Then, they make site visits to these places to gather samples inside and outside of the home. Lead contaminated dust, paint chips, water, vinyl miniblinds, toys, jewelry, and glazed ceramic ceramics are the most common sources for exposure. When all major sources for lead exposure have been tested and exhausted, REHS look to alternative sources of lead exposure. Thus, the project of my field experience was focused on the alternative sources of lead exposure.

Project

Project Background

The data collection and subsequent reports of alternative lead sources allowed REHS and Dr. Gaetz to detect a pattern of cases in Wake County. This pattern indicated elevated lead levels in children residing in newer home constructions (1980 or newer). In such cases, the possibility of contact with lead via parental occupations, hobbies, toys, or other common exposure sources were eliminated. The only remaining link to the high lead levels found in the homes occurred in the spices and home remedies frequently consumed by these children. This discovery led the researchers to begin spice and homeopathic remedy testing more diligently.

My research interest piqued at the lack of evidence suggesting these children actually consumed enough spices and home remedies to exhibit lead poisoning. In a meeting with the FDA, Dr. Gaetz explained the significance of these specific case incidences in Wake County. However, the FDA officials contended that their data modeling showed no feasible means in which these children were exposed to spices and home remedies at high enough rates for lead poisoning.

The main objective of my field experience was to develop a culturally appropriate survey for REHS to ask during their home visits to children who have elevated blood lead levels. The data gathered in this survey will assist in building a case buttressing the findings that children are indeed consuming high enough levels of spices and home remedies to experience lead poisoning. This undertaking is an effort to not only garner the attention but the action of the FDA. It is my fervent hope that this will move the FDA

to not only establish a "no tolerance" policy in regards to lead, but also to provide and enforce stricter growing, production, and import regulations.

During my field experience, I performed extensive research encompassing lead exposure, a literature review, and thorough analysis of survey techniques. In addition to these facets, I also contacted populations at risk, hosted a focus group, and attended meetings, including the NC Lead and Healthy Homes Task Meeting. Perhaps one of the most influential parts of the study came with the opportunity to observe the essential role played by a State Environmental Epidemiologist.

Spice and Home Remedy Background

Spices and home remedies are a fundamental element of many cultures around the world, especially in South Asian and Hispanic populations. Spices are specific parts of a variety of tropical plant species—generally the product of the flower, fruit, seed, bark, or root[21]. These substances have pungent tastes and piquant aromas; for this, they are incorporated into numerous popular dishes. Spices bring together a sense of identity that enrich lives and bring people together around the dinner table. Historically, these granules were used for thousands of years and are considered by many to hold natural, homeopathic properties to remedy various ailments[32]. Due to their savory pervasivity, they are consumed frequently in the United States. Interestingly, in 2014 the United States' total population boasted 318.9 million and 287.65 million people reported prevalent spice consumption [43, 54].

Case Incidence

Occurrences of childhood lead poisoning due to spices and home remedies have been occurring for longer than health officials have noticed and unfortunately the history of it in the Childhood Lead Prevention Program is not whole. It was not until 2009 that health officials in North Carolina correlated cases and started testing for suspect contaminated spices and home remedies. Rick Wagoner, Lead Program Coordinator at that time, did an environmental lead investigation with Christy Klaus, REHS. The child consumed chamomile that was tested at 0.65 ppm of lead through ion-chromatography mass spectrometry.

Since then, isolated cases are emerging across the state. Due to lack of documentation, absence of systematic data collection system, outdated state laboratory equipment, and other necessary department resources, there are barriers in accurate case reporting. Health officials strongly suspected that there could be cases linked solely to spices and home remedies but it was not until 2010 when the North Carolina State Laboratory received an inductively coupled plasma mass spectrometry machine. This machine is capable of isolating micrograms of lead in the spices and home remedies, exactly the asset public health officials need to provide evidence and confirm cases.

In April 2016, the Childhood Lead Prevention Program had a conference call with the FDA Atlanta District Office specifically about these case incidences. Since then, they have had a strong relationship. Every time a spice or home remedy comes up positive for

lead contamination, a sample is sent to the Southeastern Regional Office of the FDA for further testing and action.

Table 1: Blood Lead Level Preliminary Results µg/dl (N=15)

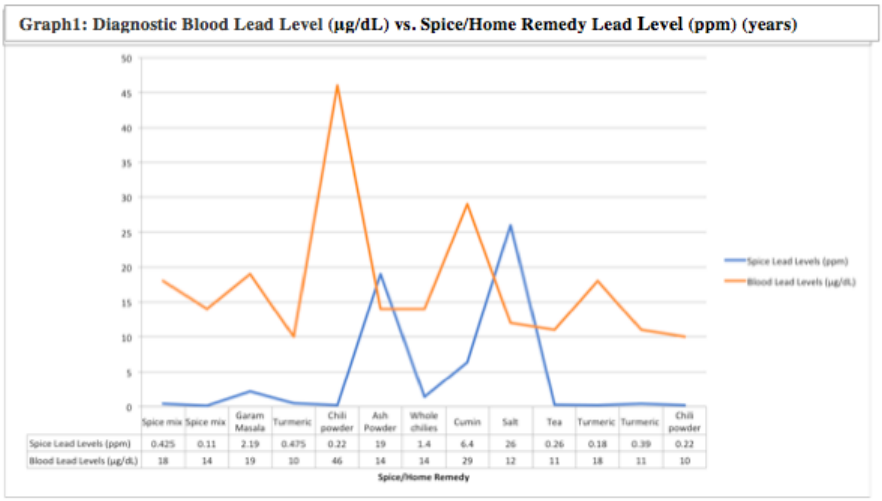
Type of Test	Average Result	Minimum Result	Maximum Result
Screening	20.6	6	64
Diagnostic	16.5	10	46

NC LEAD Database

Subsequently, there has been more emphasis on training REHS to test for lead in alternate sources, like spices and home remedies, as well as more accurate reporting and data keeping through NCLEAD. Currently, there are 29 cases involving children with elevated blood lead levels and exposure to lead-laden spices and remedies. Of these, 15 have had preliminary blood testing. Being in the investigation stage, Table 1 shows the results of the preliminary tests. The blood lead level of these children was on average 20.6 µg per dL for the screening test, and 16.5 µg per dL for the diagnostic test.

Multiple spices and home remedies have been linked to lead poisoning in children (Graph 1) in North Carolina. For instance in a case of chili powder, there was 0.22 ppm of lead detected in the spice sample with 46 µg per dL in blood sample of an individual as shown in Graph 1 lane 5. Typically turmeric, chili powder, and various masalas are the more common ones linked to these cases. According to the NCLEAD database, ranges for lead in the spices vary immensely, from less than 1 to 26 part per million. The elevated blood lead levels of these children range from 10 to 46 µg per dL**.** They come from all brands and bought at different locations or brought from overseas. Most importantly, 13 cases do not have lead-based paint sources or other environmental

exposure factors. As the graph shows, no matter what microgram of lead is in the spice, it still produces highly elevated blood lead levels. What needs immediate evaluation is



NC LEAD Database

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and amount of consumption to better understand these diagnostic levels.

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Lead and How It Gets Into Spices

Lead is a naturally occurring heavy metal in the Earth's crust and is mined and refined from naturally occurring ores[6][5]. Industrialization or anthropogenic activities are the main sources of contamination in spices. Contamination routes are as varied as the ores themselves. Industrial communities containing smelting, mining, or battery production facilities also contaminated water sources and rain droplets, causing considerable toxic contact.

From there, the lead is absorbed into the plant root and dispersed throughout the entire plant where it lies dormant until the herb is processed[7][6]. Specimens are also subject to lead adulterants via the machinery and tools throughout the production process. Oftentimes lead traces are the result of color enhancement or an attempt to increase the sale weight of the spice[7][6]. Upon the completion of processing, the spice is sold to a wholesale company that in turn imports and distributes to multiple companies. At this juncture, the spice product is brand packaged into a saleable item to fill shelves at retail outlets. Consumers may purchase spices at local grocery stores believing it is safe for consumption however, they are actually ingesting products grown thousands of miles away in countries that do not honor or impose strict environmental regulations like the United States[8][7].

Adverse Effects

As one of the most common environmentally caused, truly preventable pediatric health problem, lead poisoning is prevalent in many areas. As it stands, there is no safe amount or "acceptable standard" for lead levels in the body. Great concern should be acknowledged and care taken if a child is found with any amount of lead in his or her system. There is no level "low enough" in which adverse effects do not manifest. With no physiological value, lead causes severe toxicity to major organs including the brain, liver, and kidneys. Children commonly do not exhibit clinical signs, leading to a high rate of undiagnosed cases. Lead poisoning side effects may range from subtle onset to life-threatening immediacy[14][3] including:

- Lowered IQ

- Attention Deficit Disorder
- Anti-social behavior
- Acute encephalopathy
- Seizures
- Coma
- Death

Adverse effects in children are more visible compared to adults, as the ingestion of lead per pound of body weight is higher[1~~43~~]. Children are often more curious, leading to accidental oral ingestion. As such, a child's physiologic metabolic rate for processing lead is faster and they are more vulnerable due to developing organ systems[1~~43~~]. According to the World Health Organization (WHO), once there is a toxic level, enzymes and major minerals (such as calcium and zinc) that maintain homeostasis in the body are completely ~~inhibited[9]~~inhibited[10].

After ingestion, lead is readily absorbed into the bloodstream, where it slows down the oxygen transportation and builds up in major organs such as the brain, liver, kidneys, bone, and ~~teeth[9]~~teeth[10]. Once in those organs, it displaces heavy metals that are necessary for bodily function and blocks glutamate receptors in the brain that are necessary for ~~neurotransmission[9]~~neurotransmission[10]. This leads to learning disabilities, abdominal pain, anemia, and other side effects listed above. As for fetuses, they are at an even higher risk rate because all nutrients are received via the poisoned ~~mother[8]~~mother[9]. During pregnancy, a woman that has lead poisoning can become highly toxic to herself and the fetus due to the high rate of calcium released from her bones[10~~9~~]. Lead replenishes

the lost calcium, which travels throughout her bloodstream, across the placental barrier or through the umbilical cord, endangering the ~~fetus[9]~~fetus[10].

Regulations, Consumption, and Importation

The World Health Organization is the only world-renowned agency to set a limit for the amount of lead in spices, at 0.3 mg per kg[11~~10~~]. The FDA set a limit regulating the use of lead as a colorant in spices: 10 mg per kg[12~~11~~]. There are no guidelines established in the United States for lead levels in spices, even though the adverse effects of lead in a child's system are factual and proven in numerous studies[23~~22~~,24~~23~~]. Imported spices are strictly regulated by the FDA to insure that the product is produced in a sanitary environment and is safe to ingest. However, they do not require testing on *all* imports. In reality, testing is only conducted when the specimen reaches the warehouse and generally only examined for pesticides or bacteria - not heavy metals[13~~12~~]. The FDA will recall a spice on the market if it has repeatedly found to test at or above 1 mg per kg[13~~12~~]. The FDA set an action level in a child's body once a child is poisoned by lead; if the child has a blood lead level at 5 µg per dL, then a retest and a risk assessment should be ~~performed[13]~~performed[14].

According to the newly created scale, any spice found to have high lead content is reported to the Food and Drug Administration (FDA)[22~~21~~]. If higher than 1 part per million and bought in the United States, an FDA officer travels to the retail store to find the same brand and lot number[22~~21~~]. The officer then retests the samples from this location and if

high levels are found, the spice is recalled. Unfortunately, often the spice is purchased long ago and that lot number is already off the shelves, stopping all further FDA pursuits. Spices can be bought or be a gift from overseas. In these instances, it cannot be further tracked or located; thus, educating the family about lead poisoning is the most imperative form of prevention.

In the United States, Americans consume anywhere from 0.1 to 1.3 grams of spices per year[15][4]. This may sound like an insignificant amount in Western diets, when compared to the consumption rate of Southern India ranging from 0.4 to 2.3 grams of spices per day[16][5]. That significant increase in contaminated goods is indisputably brought to the United States when generations bring traditions from different countries of origin. Catchy advertising and the ever-increasing population reports popularize the increasing prevalence of South Asian and Hispanic cuisines. Such factors are major contributors to the increased per capita rate of spice consumption and the total domestic use of spices skyrocketing to 900 million pounds per year[13][2].

As aforementioned, the increase in consumption is attributed to an increase in population of the South Asian origins over the past ten years. Wake County, North Carolina is enriched by a growing South Asian population owing to the scientific demands of Research Triangle Park and other job market factors. According to the Census Reporter (Table 2), 32% of the foreign-born population is Asian—higher than anywhere in North Carolina and slightly higher than the total United States average[17][6]. Overall, the Asian population grew by 85% in only ten years[17][6].

Table 2: Raleigh-Durham-Chapel Hill, NC Census Report

Place of birth for foreign-born population (Table B05006) View table

Column	Raleigh-Durham-Chapel Hill, NC				North Carolina				United States			
Europe	10.8%†	±1.4%	26,404	±3,429	11.1%	±0.7%	87,866	±5,929	11.1%	±0.1%	4,789,662	±38,942
Asia	31.7%	±1.2%	77,424	±3,860	26.5%	±0.6%	210,136	±6,106	30.6%	±0.1%	13,249,179	±52,482
Africa	7.2%†	±1.9%	17,530	±4,730	6%†	±0.7%	47,503	±5,968	4.8%	±0.1%	2,062,257	±42,104
Oceania	0%†	±0.1%	98	±168	0.5%†	±0.2%	3,573	±1,826	0.3%	±0%	110,075	±9,089
Latin America	49.7%	±1.5%	121,880	±3,527	56.3%	±0.8%	447,045	±9,984	53%	±0.1%	22,949,885	±88,765
North America	0.1%†	±0.1%	210	±171	0.1%†	±0.1%	1,032	±487	0.1%†	±0%	34,749	±3,674

https://censusreporter.org/profiles/33000US450-raleigh-durham-cary-nc-csa/

With the significant increase in this demographic, trends for the use of alternative, homeopathic medicine are also on the rise. Termed “Ayurvedic”, it is one of the oldest medical beliefs, originating more than 3,000 years ago in India, and remains in the traditional healthcare system[187]. These methods are passed down for generations with the belief that phytochemicals present in spices promote healing and preventative roles in chronic diseases[187]. In fact, there are studies that researched the positive effects of such homeopathic treatments on diabetes, schizophrenia, and inflammatory conditions[187]. Interestingly, these methods are not required to meet standard safety regulations to which conventional medicine must adhere. In 2008, a National Institute of Health study found 21% of 193 products purchased and manufactured either in the United States or India had high metal toxicity, including lead[187].

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Graph 2: Spice Imports into the U.S. (2000-2014)

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Over 95% spices are imported into the United States[1,5,4]. According to the United States Department of Agriculture, 1,284,600 pounds of spices were imported into the United States in 2014[1,5,4] (Graph 2). The top five import countries include Vietnam, India, China, Indonesia, and Brazil[1,5,4]. However, the FDA checks 1% of spices for heavy metals at

import. That means only 12,846 pounds of spices were analyzed for lead contamination in 2014. In comparison, this amount is but a "drop in the bucket" against the amount imported and consumed on a daily basis.

Analytical Measurement and Reporting

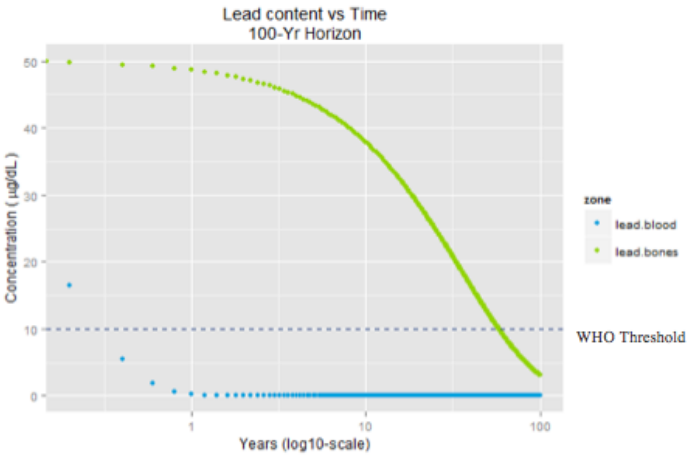
Electrothermal atomic absorption spectrometry and inductively coupled plasma mass spectrometry are the two most common methods used for analyzing lead in spices[198]. They can detect levels in spice samples as low as 1 µg per dL and blood samples as low as 0.1 ng per mL[198]. Dynamic reaction cell for inductively coupled plasma mass spectrometry can be used to better remove interferences and can detect levels as low as 0.1 µg per dL[198]. Anodic stripping voltammetry is also used on blood samples. While this is common, there are more sensitive and precise techniques now on the market[198]. Sometimes, though not typically, flame atomic absorption spectroscopy, graphite furnace atomic absorption spectrometry, or inductively-coupled plasma optical emission spectrometry techniques are used to detect trace amounts. While fantastic

advancements on their predecessors, they have greater interference potentials and can have higher detection limits than what is useful[19 8].

One of the most helpful tools in combating lead-laden specimens is a portable device that screens for lead poisoning using anodic stripping voltammetry[198]. It is simple to use, does not require skilled personnel to operate, produces rapid results, and has a reasonable detection limit (3.3 µg per dL). The aforementioned factors make it a convenient piece of equipment for a pediatrician suspecting lead poisoning in youth. However, it is not as accurate as other analyzers and should only be a preliminary screening test[198]. If a sample does come back positive, a venous blood sample should be taken and sent to a laboratory for more comprehensive testing[143].

The half-life of lead in the blood is thirty days and the half-life of lead in the bones is ten to thirty years[109]. Graph 3 compares the rate of lead metabolism in the blood versus in the bone over a one hundred year time span providing the child had lead poisoning at 50 µg per dL. When lead enters the bone, absorption may occur at a much slower rate than blood, but it remains a lifetime. This is a significant period of time in which many nutrients will become depleted and organ functions will be vastly inhibited. Urine and feces excrete lead and are therefore useful byproducts in measuring lead

Graph 3: Half-life of Lead in Blood vs. Bone over 100 years (µg/dL)



https://www.linkedin.com/pulse/plumbing-depths-lead-scandal-david-menezes

\|\WHO Threshold

poisoning but not as precise. The most accurate and popular test sample remains whole blood. It is garnered as the most acceptable sample for lead screening and diagnostic testing due to its high sensitivity and specificity[10].

In North Carolina, the general statute for all children in Medicaid, Health Choice, or Women, Infants, and Children (WIC) Program maintains that participants must be tested at 12 and 24 months old[13]. If a child is 36 to 72 months old they must be tested if they have been so previously. Refugee children must be tested at their time of arrival to the United States if they are between the ages of six months to sixteen years old. Afterwards, they must be retested three to six months after. Refugee children are in a high-risk category because they are often exposed prior to entrance. Typically, they are malnourished and lack necessary nutrients like iron, calcium, and zinc. They live in at-

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risk zip code areas that could have other lead source exposures. Internationally adopted children must also undergo blood testing. The state lab analyzes the blood lead levels and those reports go through Dr. Gaetz's NCLEAD reporting system[14~~13~~].

As stated previously, the current threshold of adverse effects is at 5 µg per dL. This is based upon the 97.5th percentile of children in the United States between the ages of one and five years old that have been tested for lead[14~~13~~]. This number is updated every four years. If necessary, chelation drug therapy is the best treatment option for poisoned children above the threshold. In 2015, there were 2,415,604 children tested for blood lead[20~~19~~]. Astoundingly, 2.83% were elevated above the threshold and 0.5% were above 10 µg per dL[20~~19~~]. When breaking down these numbers: 804,396 children across the country, in 2015, had elevated blood levels to the point they could have adverse clinical, possibly permanent, symptoms. A portion of that population's poisoning is easily correlated to their daily consumption rate of foods that contain leaded spices or remedies based on the consumption rates.

Project Objectives

The main objective of my field experience was to develop a culturally appropriate survey for REHS to ask during their home visits to children who had elevated blood lead levels. Then, I pilot tested the survey in a focus group in Wake County in order to gather information on how to best measure the exposure risk of children to lead in various spices and home remedies.

Learning Objectives

- Collect and organize appropriate data to build a focus group
- Apply principles of public health knowledge to implement a pilot survey
- Work integrally in a team of public health professionals
- Communicate efficiently with others in order to achieve section goals

Survey and Focus Group Methods

Previously, the North Carolina Department of Health and Human Services did not have an accurate way to measure the exposure to spice and home remedies that children were receiving. When there was an elevated blood lead level, an REHS would complete a home visit, sending samples of various spices and home remedies to the lab for further testing. However, this method of collection was, at best, inaccurate at collecting consistent information and entering it into the NCLEAD database due to the fact that it was an uncommon exposure source.

By creating a useful survey tool to document spice and home remedy sources the same way every time, REHS will be able to maintain accurate records in the NCLEAD database. The survey must:

- Be culturally appropriate and sensitive to a variety of demographics
- Be easy for REHS to ask the questions and write answers down
- Collect enough data without being too extensive
- Measure the data needed to present to the FDA

Working diligently with Dr. Gaetz, I created a survey (Appendix A) that could be used statewide at all elevated blood lead level home visits.

In order to ensure that the survey hit all the necessary capabilities needed for qualitative analysis, a focus group was conducted. Hosting a focus group tests the preliminary survey to ensure it is measuring the correct data needed to obtain evidence that children are being exposed to spices and home remedies contaminated with lead at higher amounts than previously modeled. Also, focus groups are useful in that they are informal group discussions engaging multiple individuals at once while being efficient and economical. Through this qualitative research, it not only helps capture real-time responses but:

- Assists in the comprehension and understanding of the way other cultures view this topic
- Raises ideas about format issues
- Measures the qualitative responses appropriately
- Starts a thorough discussion about the topic

I first created a demographic survey (Appendix B) that asked basic questions regarding age, gender, number of children, country of origin, length of time in the United States and what language is spoken at home. These foundational questions allow for the identification of cultural identity and ensure they fit into our study population.

Next, I worked on the Spice and Home Remedy Survey (Appendix A). It begins by asking if the children in question are eating solid foods. This is simply in order to rule out children currently receiving nutrition solely from breast milk. The survey moves on to cover information encompassing the family's cooking routines, to consumption frequency of spiced foods and home remedies. Lastly, the questions comprehensively cover the use of spices and home remedies from outside of the United

States. The survey concludes with a chart that allows REHS to enter data about specific spices and home remedies found in the home. Most importantly, this survey allows for distinct and specific information about the lot number data and area of origin. The survey was created so that REHS may easily and fluidly ask the questions and record data within a simple conversation. Dually, this eliminates any chances for illegible handwriting or inaccurate data collection.

Appendix C lays the "Ground Rules," reminding participants of the focus group goal. Appendix D, "Picture Index of Spices," depicts specific spices contaminated with lead. Both appendices are instrumental in overcoming any language barriers or specimen-related confusion during the focus group session. Next, working closely with Dr. Gaetz, I worked on a list of questions that were pertinent in evaluating the survey during the focus group (Appendix E). Some questions include:

- What questions were the easiest/hardest to understand?
- Which questions seemed out of context?
- Were there any questions that seemed culturally sensitive?
- What is the best ways to educate individual families on lead poisoning prevention?

I then created a visionary schedule for the proposed flow of the focus group. The basic outline (Appendix F) created a semi-organized event allowing for loose adherence to timing. Lastly, a consent form (Appendix G) is presented to ensure that all participants agreed to a voluntary, completely confidential focus group. Under this document, participants are made aware of the anonymous nature of the survey and its use solely by the North Carolina Department of Public Health.

After multiple revisions of the Spice and Home Remedy Survey, the research allowed for the planning of focus group testing and the reception of the survey in the target population: South Asian parents with children. I choose to solely approach South Asian parents due to the fact that the case incidence rate in that specific target population has been high in Wake County. Their cultural habits would be completely appreciated and understood if they knew they were in the company of peers that also had the same background.

Survey and Focus Group Results

The focus group took place on February 18, 2017 in a conference room at the West Regional Library in Cary, NC (Figure 2). This location was highly convenient to the at risk population as it not only was in the middle of the community but it also had space for the children to read and play during the time. Five adults of various South Asian ethnicities arrived to take part in the study. Each received a thank you bag with informational handouts about lead, lead coloring books for children with Crayons, business cards to contact the Childhood Lead Prevention Program, and healthy snacks (Figure 3). Participants also received nametags for familiarity and the fostering of an engaging environment.

Figure **Figure 2: Focus Group Sign**

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The recorded discussion lasted two hours (Figure 4). Initially, the group shared introductions, followed by their reasons for contribution, and finally, a 'thank you' for

participating. Next, participants received the consent form and demographic survey. Upon completion, members answered the survey after reading each question carefully. While definitive responses are helpful, the study did not require participants to answer the questions, as the concern for comprehension was greater than the actual answer. Once everyone read the survey, the group entered into an engaging conversation about how each perceived the survey and what parts could use improvement. Afterwards, Dr. Gaetz and REHS educated the group about lead exposure in spices and home remedies. They brought samples to demonstrate and gave examples of past cases. The focus group closed with express appreciation for the participant's time and gave them the contact information for Dr. Gaetz for any further questions.

Figure 3: Thank You Bags and Focus Group Materials

Figure 4: Focus Group Room

Discussion

"Exposure to environmental lead is clearly a major public health hazard of global dimensions...much work needs to be done to identify and treat children with elevated

blood lead levels and reduce lead exposure in the community", stated Shilu Tong, acting Director of the Centre for Public Health Research in Australia. As lead is the most abundant heavy metal in the Earth's crust, it is understandable that children are negatively impacted every day. Although spices and home remedies are not the biggest import market in the United States, it is a market that should not be overlooked due to the serious effects on children's formative health. With numerous children diagnosed - and undiagnosed - with lead poisoning each year, why not delve into every exposure route possible? Through policy intervention, it is imperative to maintain the utmost testing on all spices and home remedies imported into this country; ensuring, not even a minor amount slips through.

The focus group boasted enough participants to engage in a meaningful discussion. It was held in a room where we could all sit in a circle around tables to facilitate the discussion easier. All attendees fit the cross-sectional population of being parents of children under the age of sixteen. They accurately represented the South Asian ethnicity, mainly Pakistani. They not only spoke English at home but also other languages, such as Urdu, and were not born in the Untied States. The entire two hours was full of comfortable dialogue. It helped to hear from a cultural perspective how they perceived the survey.

A fear I had was that the questions were either too personal that others would be reluctant to share information or that the reader might panic at the thought that all their spices are endangering their children and change their cultural identity. As the survey creator, I did not wish to panic the reader with the information or affect their cultural identity with fear. Interestingly, all attendees agreed the survey was delivered in an

amiable manner. As such, the group felt that they now realized a plausible threat but they did not intend to stop using spices at home.

As a general rule, it is best to host at least three focus groups in order to analyze the information. However, due to time constraints, this area of my study is somewhat lacking. Statistically, this is important because it provides data saturation for not only one focus group but also across-saturation of multiple groups[210]. Saturation produces quality research because it yields enough information to replicate the focus group while no new information is attained. Failure to meet this threshold adds negative value and depth in my research[210]. Presently, another focus group will be hosted April 8, 2017. Continuing these groups is imperative to insure rich qualitative data.

While the first focus group was a success, it did lack in diversity. Ideally, having a triangulation of multiple ethnic groups will strengthen the validity of the survey. Meaning, not only hosting multiple focus groups, but each focus group is filled with participants of varying ethnicities. Having a varied cultural background provides multiple perspectives of the same phenomenon[210]. This type of sampling processing will decrease any selection bias, including undercoverage sampling. This could occur in this survey situation when the sample at risk is not correctly represented from the total population.

After the focus group, I critically evaluated the survey. The surveys taken during the focus group were not meant for completion but rather comprehension. Therefore, the survey data was not pertinent to this study. It is important to remember this survey is only used during home visits where there is no obvious exposure source like contaminated dust or water. As such, there is not enough real-time use to have any quality analysis at this time. Looking forward in analysis, I would like to have the correct

sample group for the survey. This will eliminate biases encountered when survey takers refuse to answer the survey thus causing an over or under estimation of the results. In practice, this will give accurate population parameter estimates garnering strong statistical protection.

Presently, there is not enough real time data to conduct any biostatical evaluation of the survey in the at risk population. Once it does come time, I would like to ask "Is there a significant difference in frequency of spice use among children with elevated blood lead levels and the average U.S. child that does not have elevated blood levels?" In order to ensure consistent and reliable expected values in a small population, I would use Fisher's exact test of independence. If the null hypothesis were true, then there is no difference in spice consumption between the children with elevated blood lead levels and average U.S. children, based on the averages presented. I would then state the alpha, enter data into the contingency table, and calculate the two-tailed P value.

Collected from the focus group discussion, the spice and home remedy survey is long enough to ask the necessary questions without being too burdensome for the survey-taker. As a result of the focus group, I edited several formatting errors, specifically numbering organization. Participants brought several valid points about spice use. One participant shared that oftentimes they remove these potentially contaminated spices from their original containers, placing them in crockery or other storage. Thus, the original packaging is thrown away and an important data source is then lost in that the origins and specific batch is unknown. As such, REHS cannot measure this possibly contaminated lead source aside from removing it from the home. This thought process is the perfect example to propagate the idea that free flowing discussion groups are highly effective.

Concluding my survey work, I created a second survey composed of the same questions in a different format. This allows REHS the opportunity to pick between the two (Appendix H) depending on their feeling of the home and familial environment. Offering two survey formats allows individuals room if extra space is needed to complete answers or for those needing larger font. Overall, Dr. Gaetz and I were extremely thrilled at the success and flow of the focus group and its positive perception thus far.

Impact of Lead Surveillance

As cases continue to occur in North Carolina, the Spice and Home Remedy Survey will assist in accurate and adequate data collection. In hopes of crossing language barriers and achieving cultural sensitivity, these questions facilitate conversation and broaden knowledge about what we, as consumers, are choosing to accept in our children's diets. Consumer consciousness is a growing phenomenon. The challenge to improving and protecting ourselves and our families means knowing what heavy metals are in our spices and home remedies.

Continuous monitoring of lead will broaden our understanding of the negative symptoms children present. Through focusing on the amount of contaminated spice and/or home remedy the child is consuming and comparing that to the elevation of lead levels in the blood and logging what symptoms, or lack of, would be a curious area to delve. Especially in cases where there is no other exposure source. I have started to graph the effects of how much lead is in the spice or home remedy and what their diagnostic blood lead level. However, taking it one step further by assessing the ~~roatio~~ratio of

symptoms to frequency and amount of lead in the spices and home remedies would greatly develop the data modeling.

By improving lead surveillance, there will be a decrease in child lead poisoning cases. Our country will see a decline in attention deficit and learning disability diagnoses. There will also be a unifying sense that our food supply chain is stronger than it ever was prior. The goal is not to cease the use of spices or cultural traditions, but rather to improve what has been unifying families around the dinner table for centuries: the spices we eat.

Recommendations

Once the survey has collected enough data, the FDA will be able to utilize it in their models to objectively quantify the impact spices and home remedies have in children. If the survey has a positive impact, then a number of things could take place including:

- Initiation of distributor responsibility in food safety testing,
- Standardized FDA thresholds (similar to the WHO threshold for an allowable limit of lead in spices and home remedies)
- Confirmation of the severity of the issue and the education thereof
- Recall issuance of spices consistently tested for lead contamination
- Use of media tools to ensure public awareness to initiate the recall

In order to garner awareness prompting impactful action, I would recommend performing at least two more focus groups to better test the Spice and Home Remedy Survey. The study will begin to realize success once we are confident that the survey is measuring the intended tenets of our at-risk population and is consistently used throughout the state.

Ideally, a Morbidity and Mortality Weekly Report would disseminate the information to the Centers for Disease Control and Prevention, also increasing awareness across the nation. Subsequently, this will pave the way for other state public health departments to improve monitoring spices and home remedies.

Finally, I recommend contacting Consumer Reports to set up a market basket study of various spices in retail stores around Wake County. As funds are decreasingly low at the Childhood Lead Prevention Program, performing this type of study through a branded outlet will garner much needed attention from consumers. A trusted resource, Consumer Reports would publish their findings about spices and home remedies and initiate movement towards better products.

Conclusions

Overall, this report serves to display the importance of the survey in attaining consistent testing methods of spices and home remedies during home visits. As any researcher will attest, appropriate and accurate data collection is the foundation of truly effective study. Consistent testing leads to consistent reporting and that will provide a better analysis rate of children poisoned by contaminated spices and home remedies.

The lack of reporting signifies the lack of knowledge about lead in alternative exposure sources. Most alarmingly, children ingest spices and home remedies on a daily basis. These products are imported in large quantities from countries with debilitating environmental regulations, causing lead poisoning above 5 μg per dL. Once governmental agencies take responsibility and spread knowledge about this attenuating issue in our food supply, fewer children will have lead poisoning. That is the kindest world in which we could live.

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Appendix A

Spice and Home Remedy Survey

1. Is your child currently breastfeeding?
   - ○ Yes
   - ○ No
2. Does your child currently drink any formula?
   - ○ Yes
   - ○ No
3. Besides milk or formula, what does your child eat or drink most often?

4. How often do you cook at home?
   - ○ 1-3 times a week
   - ○ 3-5 times a week
   - ○ 5-7 times a week
   - ○ I never make home cooked meals
5. What spices do you cook with every week?

6. Does your child eat foods cooked with these spices?
   - ○ Yes
   - ○ No

   6a. If yes, what foods?

   6b. If no, do you cook separate foods that have no spices for your child?
   - ○ Yes
   - ○ No

7. How much of each spice do you typically put in foods listed in 6a? *Approximate measurements of each spice in teaspoon, tablespoons, cups, or fractions of those measurements.*
8. How big of a portion does your child eat of foods listed in 6a? *List each food one by one and request a separate portion size for each type of food as you list it. May have to give an example (1 cup of soup…)*

9. How frequently does your child eat foods listed in 6a?
    - ○ Several times a day
    - ○ Once daily
    - ○ Several times a week
    - ○ Once weekly
    - ○ Several times a month
    - ○ Once monthly
    - ○ Less than once a month

10. Is there any time of year in which your child eats more of foods listed in 6a than others?
    - ○ Yes
    - ○ No

    10a. If yes, please explain what those times of year are for each food.

11. Does your child take any herbal supplements? If yes, please list them at the bottom of this page.
    - ○ Yes
    - ○ No

12. Are there any home remedies you make or buy that have spices in them, such as "golden milk"? If yes, please list them below.
    - ○ Yes
    - ○ No

Please list the herbal supplements or home remedies:

13. Do you receive spices or home remedies from family members/friends in countries outside of the United States?

○ Yes

○ No

13a. If yes, do you use those spices in your child's meals and/or home remedies?

☐ Yes, which ones?

_____

Herb/ Spice	**Lot number**	**Circle One**		**Where purchased or sent from? (City, State, Country, Address)**
		Purchased	Sent by Family/ friends	
		Purchased	Sent by Family/ friends	
		Purchased	Sent by Family/ friends	
		Purchased	Sent by Family/ friends	
		Purchased	Sent by Family/ friends	
		Purchased	Sent by Family/ friends	
		Purchased	Sent by Family/ friends	
		Purchased	Sent by Family/ friends	

_____

☐ No

Please list the following source information about the herbs and spices that you sample.

Appendix B

Spice and Home Remedy Focus Group Participant Demographics

What is your age?

- ○ 20 – 30
- ○ 30 – 40
- ○ 40 – 50
- ○ 50 and over

What is your gender?

- ○ Male
- ○ Female

How many children do you have that are less than 6 years old?

- ○ 1
- ○ 2
- ○ 3
- ○ 4 +
- ○ None

What is your country of origin?

- ○ USA
- ○ Other _____

If other, how long have you lived in the United States?

- ○ Less than 1 year
- ○ 1-5 years
- ○ 5-10 years
- ○ 10+ years

What is the primary language that you speak at home? _____

Appendix C

Spice and Home Remedy Focus Group Ground Rules

1. WE WANT YOU TO DO THE TALKING

We would like everyone to participate. I may call on you if I haven't heard from you in a while. Please allow one person at a time to talk.

2. THERE ARE NO RIGHT OR WRONG ANSWERS

Every person's experiences and opinions are important. Speak up whether you agree or disagree. We want to hear a wide range of opinions.

3. WE WILL BE TAPE RECORDING THE GROUP

We want to capture everything you have to say. We won't identify anyone by name in our report. You will remain anonymous.

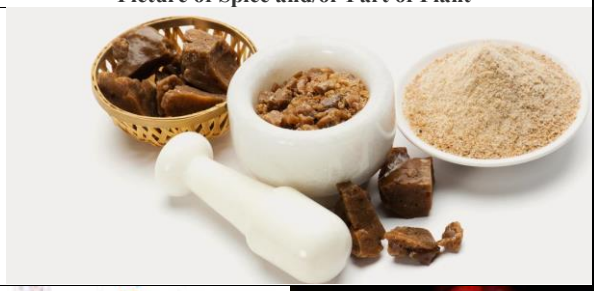
4. THIS IS STRICTLY VOLUNTARY

We appreciate your participation. Participation is strictly voluntary. It is based off of informed consent.

5. PLEASE BE RESPECTFUL OF PRIVACY

We want everyone to feel comfortable sharing when sensitive issues come up. Please do not repeat what you hear during this group conversation outside of this room.

Appendix D

Name of Spice	Picture of Spice and/or Part of Plant
Asafoetida **Hing**	
Capsicum **Kodai Mozhagai**	 
Cardamom **Ilaichi**	

Chili **Lal mirch**	
Cinnamon **Dalchini**	
Coriander **Dhania**	
Cumin **Zeera**	

Curry Leaf **Kari**	
Curry Powder (coriander, turmeric, cumin, fenugreek and chili) **Kari**	
Garam Masala (Black peppercorn, mace, cinnamon, cloves, brown cardamom, nutmeg, green cardamom)	
Ginger	

Kharchos Suneli	
Kuzhambu	
Mustard Seed **Rai**	
Paprika	

Svaneti Salt	
Tamarind	 
Turmeric **Haldi**	

Appendix E

Spice and Home Remedy Questions to Ask Focus Group

Section A: Questions about the Survey:

1. Which questions were the easiest to understand?
2. Which questions were the hardest to understand?
3. Were there any words or questions that seemed out of context?
    a. If yes, which ones?
4. Was there any place where the flow of the questions could be improved?
5. Which questions were the most difficult to recall the information?
6. What would you add to the survey?
7. What would you delete from the survey?
8. Were there any questions that seemed culturally sensitive or inappropriate?
    a. If yes, which ones?
9. How did you feel about the depth of the survey questions asked in the survey?
10. How did you feel about the length of the survey?
11. What other suggestions do you have to improve this survey?

Section B: Questions about the Topic of Lead in Spices:

1. What is the best type of media to use to deliver information widely to your community about lead poisoning prevention?
2. What is the best way to educate individual families on lead poisoning prevention?
3. If we find a pattern of certain spices or remedies with high lead content, what is a culturally appropriate way to suggest substitutions (ie. A safer brand, a safer exporter, an alternative remedy)?

Appendix F

Basic Outline of Focus Group

Introductions: 10 minutes
- Who we are
- Goals of survey and discussion
- Thank you's for coming
- Around the room introduction

Distribute Consent Form and Demographic Survey: 5 minutes
- Ask if there's any questions

Distribute Survey: 20 minutes
- Limit questions for discussion
- Explain that you do not have to thoroughly complete every question, rather think deeply about each question being asked

Discussion: 30 minutes
- Ask questions that have been created
- Allow for free form conversation but directed so not too much off topic

Closure: 5 minutes
- Conclude discussion and summarize overall impression
- Ask for any more questions
- Provide opportunity for people to pick up gifts if they want them
- Thank them again for coming out
- Give them contact information if they want any.

Appendix G

Spice and Home Remedy Focus Group Consent Form

Purpose:
The Children's Environmental Health section of the Division of Public Health is conducting a focus group of parents of children under 6. The purpose of the focus group is to pilot a survey on children's dietary intake of various spices and home remedies. Specifically, we want to understand what your opinion is of the survey. We will use this information to make the survey more user friendly. The survey will be used in home lead investigations throughout the state, in which spices are suspected as a source of lead.

Procedures:
If you choose to participate in this focus group, you will be in a group of approximately 6 to 10 parents/guardians. There will be a facilitator who will ask questions and guide the discussion, and a note-taker to write down the ideas expressed by the group. There will be a voice recorder that will record the entire session. If you volunteer to participate in this focus group, you will be asked some questions relating to demographics as well as your spice and home remedy use. These questions will help us develop culturally appropriate ways to investigate and educate people about alternative sources of lead.

Your participation is completely voluntary. You may withdraw from this focus group at any time without penalty. Everyone will be asked to respect the privacy of the other group members. You have the option to not disclose any demographic information. All participants will be asked not to disclose anything said within the context of the discussion, but it is important to understand that we cannot guarantee that other people in the group will keep all information private and confidential.

Confidentiality:
Anonymous data from this focus group will be analyzed by the Children's Environmental Health section. No individual participant will be identified or linked to the results. The results of this focus group may be used in future studies; however, your identity will not be disclosed. All information, including the voice recording and demographic information, obtained in this focus group will be kept strictly confidential. All materials will be stored in a secure location within the North Carolina Department of Public Health and access to files will be restricted to professional

staff who have been trained in safeguarding data.

Consent:
By signing this consent form, you are indicating that you fully understand the above information and agree to participate in this focus group.

Participant's signature: _____

Printed name: _____

Date: _____

Appendix H

Spice and Home Remedy Survey

1. Is your child currently breastfeeding?
   - ○ Yes
   - ○ No
2. Does your child currently drink any formula?
   - ○ Yes
   - ○ No
3. What, besides milk or formula, does your child eat or drink most often?

   _____
   _____
4. How often do you cook at home?
   - ○ 1-3 times a week
   - ○ 3-5 times a week
   - ○ 5-7 times a week
   - ○ I never make home cooked meals
   - ○ Other, _____
5. Does your child eat foods cooked with spices?
   - ○ Yes *(If yes, please refer to chart)*
   - ○ No

   5b. If no, do you cook separate foods that have no spices for your child?
   - ○ Yes
   - ○ No

6. Does your child take any herbal supplements?
    - ○ Yes *(If yes, please list them at the bottom of the page)*
    - ○ No

7. Are there any home remedies you make or buy that have spices in them, such as "golden milk"?
    - ○ Yes *(If yes, please list them at the bottom of the page)*
    - ○ No

Please list any herbal supplements or home remedies your child takes

Please list the following information about the herbs and spices that you sample.

Herb/ Spice	Brand	Lot number	Circle One		Where purchased or sent from? (City, State, Country, Address)	How often do you cook with this spice? (Weekly, Monthly, Biweekly, Everyday..)	Does your child eat foods cooked with this spice? (If yes, please write what foods)	How much of the spice do you put in the food your child eats? (tsp, tbsp, cups, fractions)	How big of a portion size does your child eat of the food cooked with this spice? (1 cup, 4 ounces..)	How frequently does your child eat foods cooked with this spice? (Several times a day/week/month, once/twice daily/weekly/monthly, every day)	Is there a time of year your child eats this food more often? (Specific religious holiday/festival)
Ex) Turmeric	*Deep Brand*	*21516*	*Purchased*	*Sent by Family/ friends*	*Raleigh, NC*	*Everyday*	*Soup Chicken Oatmeal*	*1 tsp 2 cups 5 tbsp*	*1 cup 2 ounces 2 cups*	*Several times a month Twice a week Everyday*	*During Diwali During Holi No*
			Purchased	Sent by Family/ friends							
			Purchased	Sent by Family/ friends							
			Purchased	Sent by Family/ friends							